

23.3 The 76489 sound chip

The sound chip on the BBC microcomputer is in itself a very simple chip. There are three channels for which the frequency and volume of output can be defined. There is also a fourth white noise generator. The output from all of these channels is automatically mixed on chip. The complex sound commands available from BASIC are very powerful but require a large amount of time to process, especially if complex envelopes are defined. In fast machine code programs it may sometimes be advantageous to write directly to the sound chip. The example program shows how this can

be done. The data to be written into the sound chip is first of all put onto the slow databus. Note that interrupts are disabled before this is started. The sound generator write enable line is then pulled low for at least 8 uS then pulled high again.

23.3.1 Tone generators

There are 3 tone generators. The frequency of each channel is determined by 10 bits of data. F9 is the most significant bit. The frequency of each channel can be calculated as:-

$$\text{frequency} = 4000000/32 \times 10 \text{ bit binary number}$$

The volume level for each channel is variable to 16 different levels these are:

Bit A3	Bit A2	Bit A1	Bit A0	VOLUME
0	0	0	0	15 (MAX)
0	0	0	1	14
0	0	1	0	13
0	0	1	1	12
0	1	0	0	11
0	1	0	1	10
0	1	1	0	9
0	1	1	1	8
1	0	0	0	7
1	0	0	1	6
1	0	1	0	5
1	0	1	1	4
1	1	0	0	3
1	1	0	1	2
1	1	1	0	1
1	1	1	1	0 (OFF)

SEGA CONTROL PORT \$ C00011
280 PORT \$7F

$$\text{FREQUENCY} = \frac{3.56 \times 10^6}{32 \times n}$$

23.3.2 Noise generator

The noise generator comprises a noise source and volume control. The noise generator parameters are defined by three bits.

FB – this bit when set to '0' causes PERIODIC NOISE to be generated. When set to '1' it causes WHITE NOISE to be generated.

Noise frequency control – the noise base frequency can be defined in 4 possible states by bits NF1 and NF0.

NF1	NF0	FREQUENCY
0	0	low
0	1	medium
1	0	high
1	1	tone generator 1 frequency

23.3.3 Sound chip register address field

R2	R1	R0	Description
0	0	0	Tone 3 frequency
0	0	1	Tone 3 volume
0	1	0	Tone 2 frequency
0	1	1	Tone 2 volume
1	0	0	Tone 1 frequency
1	0	1	Tone 1 volume
1	1	0	Noise control
1	1	1	Noise volume

23.4 PROGRAMMING BYTE FORMATS

The sound generator is programmed by sending it bytes in the following format:-

23.4.1 Frequency (First byte)

Register Address				Data				
Bit	7	6	5	4	3	2	1	0
	1	R2	R1	R0	F3	F2	F1	F0

23.4.2 Frequency (Second byte)

Data								
Bit	7	6	5	4	3	2	1	0
	0	X	F9	F8	F7	F6	F5	F4

Note that the second low order frequency byte may be continually updated without rewriting the first byte.

23.4.3 Noise source byte

Register Address								
Bit	7	6	5	4	3	2	1	0
	1	R2	R1	R0	X	FB	NF1	NF0

23.4.4 Update volume level

Register Address				Data				
Bit	7	6	5	4	3	2	1	0
	1	R2	R1	R0	A3	A2	A1	A0